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Food Allergies and Australian Combat Ration Packs

*J.E. Carins and K.J. Smith**

Human Protection and Performance Division
Defence Science and Technology Organisation

***Deakin University**

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ABSTRACT

Food allergy is an immunological reaction to a component of food. Allergic responses are often immediate and can be minor, moderate, serious, or even result in death. Food allergies are believed to affect 2–5% of the general population, with children affected more commonly than adults. Eight major food allergens—milk, eggs, finfish, shellfish, tree nuts, peanuts, wheat and soybeans—are responsible for most allergic reactions, and food producers are required by law to declare these allergens where present in their food. Individuals with a food allergy are unlikely to be accepted into the ADF, but there is a small chance that persons, including civilians, suffering from food allergy may consume ration packs. The current CR1M was examined to determine if it would be practicable to remove nuts or other major allergens from the menus. The removal of four specific items—for which alternatives can readily be identified—from the current CR1M menus would result in CR1M being free of nut/seed ingredients. However, there are nutrition-related penalties involved in this course of action. Designing a major-allergen-free ration pack is not considered to be practicable nor desirable.

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Executive Summary

Food allergy is an immunological reaction to a component (the allergen) of a food. The resultant symptoms may affect the gastrointestinal tract, respiratory tract, skin, a combination of any of these, or the whole body. An allergic response commonly occurs just minutes after consuming the food, and symptoms may last as long as a few days or even weeks. Depending on the sensitivity of the individual, the potency of the allergen and on the amount of allergen consumed, these can be minor, moderate, serious, or can even result in death.

There is uncertainty about the prevalence of food allergies, but the literature suggests they affect around 2–5% of the population, with the rate higher in children than in adults. Eight major food allergens—milk, egg, finfish, shellfish, tree nuts, peanuts, wheat and soybeans—are responsible for 90% of all allergic responses and the most severe reactions. Peanuts and tree nuts account for ~93% of fatalities from food-induced anaphylaxis.

Food producers are required by law to declare the major food allergens present in their food to minimise the risk of accidental exposure to allergens. Some sectors of the food industry are going further than meeting their legal obligation to declare all allergens—they are removing unnecessary major allergens from their products or menus.

Individuals with a food allergy are unlikely to be accepted into the Australian Defence Force (ADF), but there is still a chance that persons, including civilians, who have a food allergy may consume combat ration packs (CRP). With this in mind, the 2008/09 Combat Ration One Man (CR1M) menu was examined to determine if it would be feasible to provide a nut-free or major-allergen-free menu.

The elimination of nuts and seeds as ingredients would greatly reduce the probability of an adverse outcome following the consumption of a ration pack. The removal of four readily substituted items—Chocolate and Vanilla Confectionery Spreads (hazelnuts), Beef Teriyaki (sesame oil) and Vitalife Wellgrain Biscuit (sesame seeds)—would result in none of the current CR1M menus having nuts or seeds as an ingredient. However, it may not be appropriate to do this as nuts are a nutritious snack on their own, and contribute valuable nutrients to a composite food. Nuts and trail mix (which includes nuts) were found to be popular and well consumed during the trial of the Prototype Hot Weather Ration and many of the requests or suggestions for new CRP items are for nuts or trail mix.

Design of a major-allergen-free menu, whilst not impossible, is substantially more challenging. Items that contain fish, milk and wheat all make major contributions to the nutritional content of the menus. Soy is often used in processed foods, and only processed foods are suitable for use in ration packs. It is considered neither feasible nor desirable to design a major-allergen-free ration pack. Should it be considered necessary, major-allergen-free items would need to be identified, menu(s) constructed and assessed for nutritional adequacy, and items tested to ensure they are suitable for use in ration packs. Guidelines would also need to be developed for use of these packs (e.g. only humanitarian emergency) to ensure that individuals were not consuming these menus for long periods, as it is likely such usage would increase the risk of micronutrient deficiencies.

DSTO recommends that Defence:

- **Clarifies circumstances under which ration packs may be distributed to non-Service persons.**
- **Does not attempt to produce a combat ration pack that is free of major allergens.**
- **Considers design and development of a low- or reduced-allergen ration pack for use by non-Service persons.**

Authors

J.E. Carins

Human Protection and Performance Division

Julia Carins, BSc, MBA (Tech Mgt) is part of the Nutrition and Food Technology group of the Human Protection and Performance Division. Since joining DSTO in 1996, she has been involved with many research projects of varying nature, including work on the development of a prototype hot weather ration, iron supplementation for female cadets, calcium intake of female cadets, salivary markers of immune function, nutritional analysis of combat ration pack items and determination of food acceptability. Her special interests are the behavioural aspects of eating, food preferences, food attitudes and eating patterns.

K.J. Smith

Deakin University

Kimberley Smith is a student from Deakin University, who joined DSTO as part of the Summer Vacation Student program during her undergraduate degree in 2008/2009. She was at the time completing a Bachelor of Food Science and Nutrition and has since been accepted into the Masters of Dietetics course at Deakin University.

Contents

1. INTRODUCTION	1
2. ADVERSE REACTIONS TO FOODS	2
2.1 Symptoms of Food Allergy — Overview	2
2.2 The Prevalence of Food Allergy	3
3. THE MAJOR FOOD ALLERGENS	4
3.1 'Legumes, Nuts and Seeds'	4
3.1.1 Peanuts.....	5
3.1.2 Soy	5
3.1.3 Tree nuts	6
3.1.4 Sesame Seeds	6
3.2 Fish and other Seafood	6
3.2.1 Shellfish.....	7
3.2.2 Finfish.....	7
3.3 Milk	7
3.4 Egg	8
3.5 Wheat	8
3.5.1 Wheat Allergy	8
3.5.2 Coeliac disease.....	9
4. FOOD LABELLING REQUIREMENTS.....	9
5. ACCESS TO CRP	11
5.1 Service Personnel	11
5.1.1 Applicants	11
5.1.2 Serving Personnel	11
5.2 Cadets and other Non-Service Personnel.....	12
6. EXAMINATION OF CURRENT CRP	15
6.1 Methods.....	15
6.2 Elimination of 'Nuts' and Seeds as Ingredients in CR1M Food Items.....	15
6.3 Elimination of Major Allergens as Ingredients in CR1M Food Items	16
7. DISCUSSION	18
8. CONCLUSIONS	20
9. RECOMMENDATIONS.....	21
10. REFERENCES.....	22
APPENDIX A: 'NUT' AND SEED CONTENT OF CR1M	27
APPENDIX B: CR1M — NUT AND SEED INGREDIENTS REMOVED	29
APPENDIX C: 'MAJOR ALLERGEN' CONTENT OF CR1M.....	31

1. Introduction

Consumers reasonably expect that the food they obtain is safe to eat. The food industry has a legal obligation to abide by the food standards that regulate substances added to food, contaminants, residues, microbiological limits and labelling. The aim of this legislation is to ensure a safe food supply and well-informed consumers (FSANZ 2009).

For one set of consumers—those who suffer from a food allergy—food consumption is a risky and potentially life-threatening activity. Very small amounts of an allergen can trigger a reaction, meaning avoidance of that particular allergen is necessary. Affected individuals scrutinise food labels to ensure that the chosen food does not contain the allergen in question. By law, food producers must list food allergens in, after, or next to the ingredients list to minimise the risk of accidental exposure to allergens (FSANZ 2002).

At present the responsibility lies with the allergy sufferer to make informed choices about which foods are safe to eat. However, some sectors of the food industry are going further than just meeting their legal obligation to declare all allergens, by developing ‘free-from allergen’ products and ‘allergen-free’ food service practices. This is not only a risk management exercise, but a response to demand for these products and services. For example, Qantas has removed peanuts as a snack from all its flights and lounges, has minimised the use of peanuts or peanut based products in their in-flight menus, and provides an extensive range of special meals designed to exclude peanuts, other nuts, or products of peanuts or other nuts (Qantas 2009).

The Australian Defence Force (ADF) conducts medical screening of recruits and, depending on the severity of any identified allergy, may reject an applicant on medical grounds. During the annual medical assessment—necessary for individuals to meet individual readiness requirements—a serving member may be deemed to be medically unfit for service if they have been diagnosed with a food allergy or intolerance. Therefore, ADF members should not be affected by eating combat ration packs (CRP) that contain potential allergens. However, anecdotal evidence suggests that CRP have been used by non-service personnel who, as part of the general population, may have a food allergy.

The ADF is considering what further measures could be taken to tackle the issue of food allergies. As part of a VCDF Task (07/082), DSTO was tasked to review the composition of CRP in order to provide some menu options that are free of peanuts, and to review the feasibility of providing a ration pack free of those ingredients that are the most common causes of severe food allergies.

This report details the results of that review, including: description of the major food allergens, their symptoms, severity and prevalence; results of examination of the current CRP menus for allergens; menu options that are free from nuts; and discussion of the feasibility of developing major-allergen-free ration menus.

2. Adverse Reactions to Foods

Several terms are used when discussing adverse reactions to foods. Their meanings often differ between medical and lay people, and can be influenced by social and cultural perceptions (Hadley 2006). Therefore, it is necessary to define some of the terms to avoid ambiguity.

A *toxic reaction* will occur when any individual is exposed to a toxic compound, provided the dose is high enough, whereas a *non-toxic reaction* is dependent on individual susceptibility to a particular compound (Brujinzeel-Koomen *et al.* 1995). There are several types of non-toxic reactions, so for the purposes of providing a common understanding, the World Allergy Organisation (WAO) recently revised the terminology for allergic and nonallergenic reactions (Johansson *et al.* 2004). This terminology has been widely accepted. Johansson *et al.* (2004) state:

Hypersensitivity should be used to describe objectively reproducible symptoms or signs initiated by exposure to a defined stimulus at a dose tolerated by normal persons.

Food hypersensitivity can be further divided into two categories, as defined by the WAO:

The appropriate term is *food allergy* when immunologic mechanisms have been demonstrated. All other reactions should be referred to as *nonallergenic food hypersensitivity*.

The term ‘food intolerance’ has previously been used to describe nonallergenic food hypersensitivity and includes such conditions as lactose intolerance and sulphite hypersensitivity.

Food allergy is ultimately an immunological overreaction. The first time a susceptible individual is exposed to the food, no symptoms are apparent. Rather than processing the food as a harmless substance, the immune system of that person identifies a particular protein in that food as a threat. The result is production of antibodies (immunoglobulin E or IgE) which recognise that particular food protein during subsequent encounters and initiate a range of protective mechanisms, including swelling and isolation of the affected area (Lessof 1995). The protective mechanisms are initiated upon contact with the allergen, therefore many of the symptoms are localised, affecting the skin and lining membranes of the body. Should the allergen proceed beyond the local defences and circulate to other parts of the body via the bloodstream, a larger, more widespread reaction can occur that simultaneously affects many parts of the body (Lessof 1995). This type of reaction is known as *anaphylaxis*.

There are also some non-IgE immunological reactions to food, for example coeliac disease, which is a severe form of malabsorption due to an immunological reaction to gliadin, a component of gluten (Chapman *et al.* 2006).

2.1 Symptoms of Food Allergy — Overview

An allergic response commonly occurs just minutes after consuming the food and symptoms may be short-term or may last as long as several days or even weeks. The symptoms experienced following exposure to the allergen vary depending on the amount of allergen consumed and the sensitivity of the individual (WHO 2006). Individuals may suffer symptoms

affecting the gastrointestinal tract, respiratory tract, skin, a combination of any of these, or the whole body (Table 1).

Table 1: Symptoms of Food Allergy [adapted from Bahna (2003)]

Area Affected	Symptoms
Gastro-intestinal system	Oral allergy syndrome (swelling or itching of the mouth, lips, throat or tongue) Nausea/vomiting Colic (abdominal cramps/pain) and bloating Diarrhoea
Respiratory system	Rhinitis (irritation and inflammation of the nose) Laryngeal oedema (swelling/tightness of the larynx) Cough Asthma
Dermatologic system	Chronic otitis media (middle ear infection) Atopic dermatitis (skin inflammation, itching, eczema) Urticaria or hives (skin rash) Angiooedema (generalised swelling)
Other	Generalised anaphylaxis

Anaphylaxis is the most severe reaction, usually affecting a number of organ systems. The WAO defines anaphylaxis as ‘a severe, life-threatening generalised or systemic hypersensitivity reaction’ (Johansson *et al.* 2004).

Diagnostic criteria for anaphylaxis include combinations of acute onset of illness; involvement of the skin and/or mucosal tissue (i.e. swollen mouth/tongue); respiratory difficulty; reduced blood pressure; and persistent gastrointestinal symptoms (Sampson *et al.* 2006). Anaphylaxis is a life-threatening condition and the primary treatment is epinephrine injection as soon as possible, with follow up emergency care (Wang and Sampson 2007).

2.2 The Prevalence of Food Allergy

There remains a great deal of uncertainty in the literature about the prevalence of food allergies, mostly due to the variety of methods used to diagnose food allergy. Studies conducted using a double-blind, placebo-controlled food challenge method (the gold standard of diagnosis) report an overall prevalence in the range of 2–5% (Chapman *et al.* 2006).

There is a lack of solid data on the prevalence of food allergy in Australia. Prevalence has been estimated at 1.5% in the adult population, as tested by positive skin prick test (Woods *et al.* 2002a). Another study using an internet survey found a much higher prevalence—29.3% of Australian households reported at least one member with a food allergy (Allen *et al.* 2009). The public perception of allergy apparently leads to a higher self-reported incidence than that found when using objective measures. This may be due to the mistaken assumption that a previous bad food experience was actually caused by a food allergy, or that a food intolerance (a nonallergenic food hypersensitivity) is actually a true food allergy. Indeed, the study by Allen (2009) found that only 18% of claimed allergies had been diagnosed by a doctor and 4% by an allergist, and recommended that more formal evaluation should be conducted in Australia.

Food allergies appear to be becoming more prevalent within society (Grundy *et al.* 2002, Mullins, Dear and Tang 2009, Sicherer, Muñoz-Furlong and Sampson 2003). In Australia the number of hospital admissions due to food-related anaphylaxis has increased dramatically,

averaging a 13% increase per year over the period 1993/4 to 2004/5. Six deaths from food-related anaphylaxis occurred during this period (Poulos *et al.* 2007). This trend has been seen in the USA and the UK as well (Anderson, Lin and Shah 2008, Gupta *et al.* 2007).

A recent study in a Canberra-based immunology/allergy practice found that the number of children diagnosed with food allergy increased by 10% per annum over the period 1995 to 2006 (Mullins 2007). They suggest that this increase may be due in part to community awareness increasing the demand for children to be assessed for food allergy before school enrolment, but conclude that systematic research on the epidemiology of food allergy in Australia is required. It is generally accepted that the prevalence is higher in children than in adults (Loza and Brostoff 1995) and that some children will outgrow their allergy.

3. The Major Food Allergens

Eight major food allergens are responsible for 90% of all allergic responses and most severe reactions. They are cow's milk, hen's egg, finfish, shellfish, tree nuts, peanuts, wheat and soybeans (Bousquet *et al.* 1998). Of these eight major food allergens, peanuts, tree nuts, shellfish and finfish are most likely to cause anaphylactic reactions (Burks *et al.* 1999). More than 160 other foods are known to cause allergies but these allergies are relatively rare (Hefle, Nordlee and Taylor 1996).

At present, reduction of the risk of an allergic reaction to a food relies on provision of accurate information on the label detailing the composition of the food, thereby allowing avoidance of particular foods by susceptible individuals. To achieve consistency in food labelling standards across nations, a list of the most common food allergens was developed by a Joint FAO/WHO Expert Committee. Foods from this list were evaluated against the following scientific and objective criteria—reports of allergenicity following a double-blind, placebo-controlled food challenge (DBPCFC) and reports of systemic and life-threatening reactions (Bousquet *et al.* 1998). The foods that met the criteria included: 1) wheat, 2) crustaceans, 3) eggs, 4) fish, 5) peanuts and soybeans, 6) milk, 7) sulphite in concentrations of 10 mg/kg or more and 8) tree nuts (other than coconut) and sesame seeds (Bousquet *et al.* 1998). These foods have been widely accepted as the most common food allergens and are to be declared on product labelling according to legislation adopted by most nations, including Australia and New Zealand.

Of these, the most common allergens in young children are milk, egg, peanuts, soy and wheat, although most children will be able to tolerate milk, egg, soy or wheat by the age of five. Allergies to peanuts, tree nuts and seafood tend to persist through to adulthood. For adults, allergies to peanuts, tree nuts, shellfish and finfish are the most common, and generally they have persisted since childhood (Chapman *et al.* 2006).

3.1 'Legumes, Nuts and Seeds'

Peanuts and tree nuts are responsible for the majority of fatalities due to food-induced anaphylaxis, causing 94% of the fatalities registered in the USA in the five-year period 1994 to 1999 (Bock, Muñoz-Furlong and Sampson 2001). Due to the severity and potentially fatal nature of allergic reactions to peanuts and tree nuts, these two foods have attracted the most research

attention and community awareness, and have been removed or banned from many schools and childcare institutions.

Of the ‘legumes, nuts and seeds’, peanuts and soy (legumes), tree nuts and sesame seeds (but not other seeds) were considered to meet the criteria for inclusion on the list of food allergens for labelling (Bousquet *et al.* 1998).

3.1.1 Peanuts

Peanuts (a member of the legume family, closely related to peas and beans) are the most frequently cited source of life-threatening allergic reactions. They account for at least 25% of food-induced anaphylactic reactions (Burks *et al.* 1999) and 60% of fatalities (Bock, Muñoz-Furlong and Sampson 2001). Not only can peanuts cause severe allergic reactions when consumed, but even a very small amount—as little as a 0.25 mg—of peanut protein is capable of causing a reaction (Taylor *et al.* 2002). In particularly sensitive individuals, even inhalation may produce a severe reaction (Chapman *et al.* 2006). Consequently, those with peanut allergies face the challenging task of avoiding all peanut-containing products throughout their life (Sicherer and Sampson 2007). It is generally thought that children do not outgrow allergy to peanuts, although it appears that one child in five may do so (Skolnick *et al.* 2001).

The symptoms of a peanut or tree nut allergy develop within a few minutes to a few hours after ingestion and are often initially in the lips, mouth and throat. Other symptoms may include digestive problems (diarrhoea, stomach cramps, nausea or vomiting), tightening of the chest, shortness of breath or wheezing and a runny or stuffy nose. In highly sensitive individuals, loss of consciousness and death can occur within minutes of ingestion (Loza and Brostoff 1995).

In the USA, a survey of 13 493 participants randomly interviewed over the telephone found that 1.2% reported peanut allergy, with 79% of those having experienced respiratory or multiple organ reactions (Sicherer, Muñoz-Furlong and Sampson 2003). In Australia, peanut allergy is suspected to affect 2% of children and 0.5% of adults (Hill *et al.* 1997, Woods *et al.* 2002b). Curiously, studies have found that the occurrence of peanut allergy is higher in women than men, but higher in boys than girls (Emmett *et al.* 1999, Sicherer, Muñoz-Furlong and Sampson 2003). It is not known why this is the case.

3.1.2 Soy

Soy proteins tend to be less reactive than many other food proteins (Cordle 2004). Reactions to soy affect the skin, respiratory and gastrointestinal systems, and symptoms are generally mild or moderate in severity. In 13 years of testing, investigators did not observe any severe allergic reactions in a double-blind, placebo-controlled, food challenge using soy (Sicherer, Morrow and Sampson 2000). Individuals allergic to one member of the legume family may have an immunological reaction to one or many of the others, however this reaction may not be clinically significant (Bousquet *et al.* 1998). Severe systemic reactions, including fatal anaphylaxis, have been reported after ingestion of soy, but in all cases victims also had severe peanut allergies and asthma (Cordle 2004). Soy allergy is relatively uncommon compared with peanut, egg or milk allergy; the prevalence of soy allergy in the adult population is estimated to be less than 1% (Zuidmeer *et al.* 2008).

3.1.3 Tree nuts

Tree nuts—almonds, cashews, Brazil nuts, hazelnuts, pecans, pistachios, chestnuts, pine nuts, macadamias and walnuts—can cause similar reactions to those produced by peanuts, including death, accounting for 33% of fatalities due to food-induced anaphylaxis (Bock, Muñoz-Furlong and Sampson 2001). Of the tree nuts, cashews and walnuts are the most common cause of severe allergic reactions (Fleischer *et al.* 2005). Tree nut allergy often persists throughout life, and fewer than 10% of those with a tree nut allergy are likely to outgrow it. Prevalence estimates vary for the different types of nuts—as low as <1% for almonds, walnuts, cashew, pecan nuts and Brazil nuts, and as high as 4% for hazelnuts (Zuidmeer *et al.* 2008).

3.1.4 Sesame Seeds

Although not considered to occur frequently, sesame seed allergy can be quite severe, resulting in systemic reactions and anaphylactic shock (Morisset *et al.* 2003). The prevalence of sesame seed allergy has been estimated at less than 1% (Zuidmeer *et al.* 2008) although some consider it to be increasing in prevalence (Bousquet *et al.* 1998, Kanny, De Hauteclocque and Moneret-Vautrin 1996).

3.2 Fish and other Seafood

Seafood allergy has also received attention as it is relatively common, can provoke severe reactions, and reactions can occur after indirect exposure. Generally, exposure is via accidental ingestion, although handling fish can cause allergic reactions (Dominguez *et al.* 1996, Jeerhay *et al.* 2008). Although a rare occurrence, inhalation of airborne fish particles has been known to cause anaphylactic shock in particularly susceptible individuals, and others are sensitive to seafood fumes, such as those produced when cooking seafood (Crespo *et al.* 1995). Allergic reactions can become apparent within two hours, but may take as long as six to twelve hours to appear. Symptoms include skin irritation, swelling of the face, breathing problems, abdominal pain, vomiting, diarrhoea, nausea, dizziness, light-headedness, tightness in the chest and nasal congestion, sometimes resulting in anaphylaxis and even death.

Seafood allergy often develops in adulthood, and it appears most people do not lose their allergy over time. The prevalence of seafood allergy in adults has been estimated to be between 1.3% and 2.8% (Sicherer, Muñoz-Furlong and Sampson 2004, Vierk *et al.* 2007). It is considered to be higher in communities with a high proportion of fish in the diet (Lopata and Lehrer 2009). Similar to peanut allergy, the occurrence of seafood allergy appears to be higher in women than in men (Sicherer, Muñoz-Furlong and Sampson 2004, Vierk *et al.* 2007). These researchers found seafood allergy to be twice as prevalent as peanut allergy, as determined in the same study (Vierk *et al.* 2007) or by the same methodology (Sicherer, Muñoz-Furlong and Sampson 2003). These estimates, based on self reports of physician/doctor diagnosis of allergy, need to be viewed with caution, but do raise an interesting point—if our Australian population is similar to that of the USA, seafood allergy could be a greater problem here than first thought. Another point to consider is that adverse reactions to seafood can occur as a result of exposure to other contaminants—bacterial (*Salmonella*, *Listeria*), viral (Hepatitis A, rotavirus), parasites or toxins—and may present with similar symptoms (Lopata and Lehrer 2009). This could result in an overestimate of the prevalence of seafood allergy when the estimates are based on self reports.

3.2.1 Shellfish

Shellfish include crustaceans (crabs, lobster, crayfish, shrimp and prawns) and molluscs (mussels, oysters, scallops, clams, squid and octopus). Individuals may react to a single type of shellfish, only to crustaceans, only to molluscs, or to all shellfish (Sicherer, Muñoz-Furlong and Sampson 2004). Shellfish allergy has been reported in both European and American studies to affect around 2% of the population (Rona *et al.* 2007, Sicherer, Muñoz-Furlong and Sampson 2004, Vierk *et al.* 2007). There is little data on the prevalence in the Australian population.

3.2.2 Finfish

Finfish include cod, flounder, hake, trout, haddock, halibut, herring, mackerel, pike, salmon, shark, snapper, sole and tuna. Finfish allergy affects around 0.5% of the population in the USA (Sicherer, Muñoz-Furlong and Sampson 2004, Vierk *et al.* 2007), a finding supported by studies from other countries (Rona *et al.* 2007). Interestingly, the allergenicity of fish may be reduced during processing. One study found those people with allergy to tuna or salmon were able to eat *canned* tuna or salmon during an open challenge, and had been doing so without incident for some time previously (Bernhisel-Broadbent, Strause and Sampson 1992). More recently it has been discovered that the dark muscle of fish (also called red muscle, used for continuous swimming) was less allergenic than the white muscle (also called light muscle, used for short bursts of swimming), due to a lower concentration of the allergenic compound parvalbumin (Kobayashi *et al.* 2006). Tuna has more dark muscle than other fish. Another finding from the same study was that yellowtail tuna is extremely low in allergenicity; the authors conclude that although avoidance of all fish is still recommended for those who have finfish allergy, some may be able to tolerate yellowtail tuna (Kobayashi *et al.* 2006). Future research may provide more knowledge in this area, and may lead to development of low-allergen tuna products.

3.3 Milk

Cow's milk allergy is predominantly seen in children, particularly in early childhood, affecting 2–6% of children (Exl and Fritsché 2001, Garcia-Ara *et al.* 2004, Hill *et al.* 1997) and is the most common allergy in infancy. Many children outgrow their allergy to cow's milk. Studies have shown that cow's milk allergy in children can resolve by school age (Høst and Halken 1990, Saarinen *et al.* 2005) although others have demonstrated that it can persist longer, well into adolescence (Skripak *et al.* 2007). In Australia, cow's milk allergy has been reported to affect less than 1% of the adult population (Woods *et al.* 2002b), a prevalence similar to that found in Europe (Rona *et al.* 2007).

Cow's milk allergy is complex as it can involve IgE-mediated or non-IgE-mediated immunological reactions, or both (Crittenden and Bennett 2005). Symptoms can include effects on the skin (eczema, itching, swelling), gastrointestinal systems (itching/swelling in the lips, mouth and throat, nausea, vomiting and diarrhoea) or respiratory system (rhinitis, conjunctivitis, asthma) (Hill *et al.* 1997). Symptoms may appear quickly or up to several days later, and can occur after consumption of very small amounts of milk (Morisset *et al.* 2003). Although anaphylactic reactions to cow's milk have been documented, they are relatively rare (Eigenmann 2002).

In contrast to milk allergy, lactose intolerance is the term used to describe a condition that involves either lactose maldigestion or lactose malabsorption. Sufferers fail to produce sufficient lactase, an enzyme that is required to digest lactose (milk sugar). As a result, lactose is not fully hydrolysed or absorbed in the small intestine, but passes into the colon where fermentation of the remaining lactose occurs. The symptoms that result include flatulence, bloating, diarrhoea and abdominal pain, and can be similar to some of those experienced with cow's milk allergy. Lactose intolerance is dose-dependent, and depending on the individual, small amounts of lactose can often be consumed without eliciting ill-effects (British Nutrition Foundation 2000).

3.4 Egg

Allergy to hen's egg is common in infants and young children. Exposure is usually by ingestion, but some children experience symptoms after skin contact (Chapman *et al.* 2006, Yamada *et al.* 2000). It is thought that the majority of children outgrow egg allergy by school age, although a recent study demonstrated a much slower resolution (Savage *et al.* 2007).

Allergic responses to eggs usually occur within a few hours after eating eggs or foods containing eggs. Symptoms vary and commonly include skin rashes or inflammation, occasionally vomiting and other gastrointestinal symptoms (Heine, Laske and Hill 2007). Symptoms are not usually severe, but death from egg allergy has been reported (Pumphrey and Gowland 2007).

In Australia, egg allergy is reported as the most common childhood allergy, affecting 3.2% of children (Hill *et al.* 1997), but has a prevalence of less than 0.1% in Australian adults (Woods *et al.* 2002b).

3.5 Wheat

3.5.1 Wheat Allergy

True (IgE-mediated) wheat allergy can elicit symptoms similar to other food allergies. Symptoms of wheat allergy include skin conditions (dermatitis, itching/burning sensations and swelling), oropharyngeal and gastrointestinal systems (itching/swelling in the lips, mouth and throat, nausea, vomiting and diarrhoea) or respiratory system (runny nose, asthma) and anaphylaxis (Scibilia *et al.* 2006).

Patients with wheat allergy generally do not react to other grains in food challenges (Jones *et al.* 1995). So individuals with wheat allergy are generally not required to remove all other grains (e.g. rye, barley, oats, rice, corn) from the diet (Chapman *et al.* 2006). However, constructing a suitable diet free of wheat can be challenging.

Wheat allergy is relatively rare—most studies have found a prevalence of less than 0.5% (Hill *et al.* 1997, Moneret-Vautrin and Morisset 2005, Woods *et al.* 2002b, Zuidmeer *et al.* 2008). Children often outgrow wheat allergy—resolution of the allergy was found in 65% of children by age twelve (Keet *et al.* 2009).

3.5.2 Coeliac disease

Coeliac disease is a non-IgE-mediated immune reaction to gliadin (a gluten protein), causing chronic intestinal inflammation which in turn interferes with the absorption of nutrients. This inability to absorb nutrients often leads to other health problems. Symptoms can include diarrhoea, pain, bloating, weight loss, weakness, cramps, flatulence and constipation (Green and Jabri 2003).

Coeliac disease was considered to be rare, but improved screening methods have enabled better detection and it is estimated to affect around 0.5% of the population (Fasano and Catassi 2001).

Treatment for coeliac disease is a strict gluten-free diet (no wheat, barley or rye). Oats themselves do not present a problem, although it is difficult to guarantee that commercially-available oats are free of contamination with other grains (Green and Jabri 2003).

4. Food Labelling Requirements

In Australia and New Zealand, food producers are legally required by Food Standards Australia New Zealand (FSANZ) to declare the major food allergens contained within their food, to minimise the risk of accidental exposure to allergens (FSANZ 2002). These requirements are consistent with those used in other parts of the world (FAO/WHO 2008, FDA 2004).

The following must be declared:

- *cereals containing gluten* and their products
- *crustacea* and their products
- *egg* and egg products
- *fish* and fish products
- *milk* and milk products
- *peanuts* and *soybeans*, and their products
- *tree nuts* (other than coconut) and *sesame seeds* and their products

The source must be declared for cereals (i.e. wheat, rye, barley, oats or spelt) vegetable oil (i.e. peanut, soy bean or sesame) crustaceans (crabs, lobster, crayfish, shrimp and prawns) and nuts (peanuts, almonds, cashews, Brazil nuts, hazelnuts, pecans, pistachios, pine nuts, chestnuts, macadamias and walnuts).

These foods must be declared if they are:

- an *ingredient*
- an *ingredient of a compound ingredient*
- a *food additive* or *component of a food additive*
- a *processing aid* or *component of a processing aid*

They must be declared:

- on *the label* on a package of the food

OR where the food is not required to bear a label:

- declared *on or in connection with* the display of the food
- *declared to the purchaser* upon request
- displayed *on or in connection with* food dispensed from a vending machine

Those affected by a food allergy rely heavily on the ingredient listing on food products. Therefore, any information regarding potential allergens needs to be readily available, accurate and easy to understand.

Use of statements such as 'may contain' as a generic disclaimer in an effort to protect the consumer (and the manufacturer from liability) is not helpful as it unnecessarily restricts the choice of available foods for people with allergies, and can lead to complacency when those foods are chosen on the assumption that the risk is low.

Following the introduction of legislation requiring mandatory allergen warning statements on food labels, FSANZ conducted a survey to assess the ability of those 'at risk', to successfully identify those foods that contain the allergens. They found that the ability to identify foods that contain allergens varied considerably. This was partly due to the use of complex or unclear terms (e.g. difficulty in identifying whether ingredients listed simply as 'emulsifiers' were a potential source of concern and the sources of certain vegetable oils were often not stated) and 'may contain' statements were over-used or not clear, restricting the choice of foods that were available (FSANZ 2004).

Respondents showed a preference for the disclaimer '*made on the same equipment as products containing ...*', over the statements '*may contain traces of ...*', and '*made in the same premises as products containing ...*'. However, over a third (37%) still said that the '*made on the same equipment ...*' statement was not very useful (FSANZ 2004).

Food allergens can become part of a food through an unintended exposure during the production process. This may be a result of inadvertent presence of allergens in raw materials, processing aids, incorrect formulation, changes to product scheduling, rework, insufficient or ineffective cleaning/sanitation procedures, in-process cross contact and/or post-process contact. The recommended approach to allergen risk management is through a Hazard Analysis and Critical Control Point (HACCP) program, and use of the Voluntary Incidental Trace Allergen Labelling (VITAL) decision-making tree (Australian Food and Grocery Council 2007).

VITAL has been developed to provide a risk-based methodology to assess the impact of allergen cross contact and identify appropriate allergen precautionary labelling. VITAL requires manufacturers to assess the likely sources of cross contact allergenic substances from raw materials and the processing environment, evaluate the amount present, review the ability to reduce the allergenic material from all contributing sources and continually monitor and verify their processes.

The VITAL decision tree identifies three action levels: precautionary labelling is not required; precautionary labelling is required for each relevant allergen using the standard VITAL statement (**May be present: xxx**); and labelling of the allergen as an ingredient is required as significant levels of the allergen are likely to be sporadically present (Australian Food and Grocery Council 2007).

5. Access to CRP

Several population groups may have access to CRP. The health and welfare of these groups should be considered when determining the risks associated with the consumption of CRP.

5.1 Service Personnel

It is an inherent requirement of employment in the ADF for all members to be operationally deployable. Medical fitness is a fundamental requirement for entry and retention for service personnel (both regular and reserve).

5.1.1 Applicants

Medical fitness standards (Department of Defence 2008) classify an ADF applicant with a food allergy in the following way:

Food Anaphylaxis

Class 4 — permanently medically unfit for military service

Food Allergy — less severe than anaphylaxis

Class 3 — temporarily medically unfit for service

Consideration would be given to reaction time, severity and whether the foodstuff is commonly consumed, including in ration packs, following which, reclassification would be to either:

Class 4 — permanently medically unfit for military service, or

Class 1 — medically fit.

Food Intolerance, including Coeliac disease

Class 4 — Permanently medically unfit for military service.

With these restrictions in place, there is little chance that an applicant with a food allergy or intolerance would be accepted into the ADF. However, there is a possibility that individuals suffering from *Food Allergy —less severe than anaphylaxis* may be classified as medically fit after review.

5.1.2 Serving Personnel

For existing personnel it is an inherent requirement that personnel of all ranks are individually ready and able to deploy on short notice. Individual readiness comprises six components, one of which is a medical component as follows:

The ADF requires medical fitness of its members in order that they are able to undertake their operational duties. A member is deemed medically ready if they ... have completed an Annual Health Assessment (AHA), Specialist Medical (SM) or Comprehensive Preventive Health Examination (CPHE) within the preceding 12 months, and have been recommended as Medically Individually Ready (Department of Defence 2005).

Should a food allergy or intolerance be discovered at a regular medical assessment or examination, consideration is given to whether the condition impacts on a variety of factors including:

General living conditions — Living conditions ... are subject to wide variation in different parts of the world, especially during operational deployment. Members must be able to adapt to these variations and must be fit to work in the open and live under limited shelter in inclement weather conditions for extended periods, and be capable of being sustained by combat rations only.

Safety — ADF personnel must be able to perform tasks without detriment to the safety and welfare of themselves or others. A member is not medically fit for operational deployment if:

1. their functional capacity or welfare is dependent on uninterrupted access to medication, special diet, surgical aids or equipment;
2. their medical condition is prone to sudden deterioration, which could:
 - a. impact on the member's future health;
 - b. require medical evacuation;
 - c. result in a loss of skills and capability to the mission; and
 - d. require specialist medical treatment which may not be available.

These policies ensure frequent medical evaluation of serving members. They also necessitate serious consideration of the impact of any new medical conditions on the ability of the serving member to deploy or perform the tasks required as part of their service.

As a result there is little chance that a serving member with a newly discovered food allergy or intolerance would be classified as medically fit, and therefore there is little need to create allergen-free rations for service personnel.

5.2 Cadets and other Non-Service Personnel

On the 30th of March, 2007 a member of an Army Cadet Unit died on camp after consuming a Beef Satay meal from the CR1M (Department of Defence 2009b). The use or consumption of CRP under any circumstances by Army, Navy and Air Force cadets was subsequently banned across Australia until further notice (Gillespie 2007) and at the time of writing this report (March 2010) that ban had not been lifted. As cadets do not have any medical screening before entry, it is highly likely that some cadets will have one or more food allergies. Further, it is the intent of Army to remove all peanut-based products from all food sources provided by the ADF, and from all foods taken by individual cadets during Australian Army Cadet activities (Gillespie 2009).

Following the investigation into the death of the cadet, the Commonwealth was awarded a substantial pecuniary penalty and consented to the terms of an enforceable undertaking negotiated with COMCARE. This undertaking required Army (and more generally the ADF) to take a number of actions to restrict access to CRP, and provide warnings to consumers in an effort to prevent a recurrence of this type of incident.

The actions most relevant to the content of this report were (COMCARE 2009):

- Army is not to distribute, use or allow the use of ADF-supplied combat ration packs during AAC (Australian Army Cadets) activities or for non-service members, unless the following label is affixed to each inner bag in the combat ration pack:

CAUTION- FOOD ALLERGIES

This ration pack has NOT been constituted for consumers with any food allergy or special dietary requirements. You should read the contents and instruction sheet before consumption. If you have any doubts about the contents, you should not consume the ration pack. Products used in ration packs, which may contain nuts or traces of nuts, include beef, chicken satay meals, biscuits and chocolate.

- ADF-supplied ration packs distributed, used or allowed to be used by Service members are to have the warning label above affixed to the outside of the exterior cardboard packaging containing combat ration packs.
- Restrict the distribution of combat ration packs that have been produced prior to 1 July 2008 to ADF personnel only, and prohibit the distribution of such combat ration packs to members of the public and the AAC.

Actions taken by the ADF to address these recommendations include the following:

To restrict distribution:

- Prohibited issue of ADF combat ration packs to Army, Navy and Air Force cadets (Gillespie 2007). This directive was issued soon after the incident, and remains in place at the time of writing this report (March 2010). It is referenced in the Electronic Supply Chain Manual (V04S08C05 – Management and accounting for rations Australian Defence Force).
- Restricted distribution and use of ADF-supplied combat ration packs to service members only, unless the recommended “CAUTION - FOOD ALLERGIES” warning label is affixed to each inner bag in the combat ration pack (Army Headquarters 2009). This is also referenced in the Electronic Supply Chain Manual (V04S08C05 – Management and accounting for rations Australian Defence Force).
- Restricted distribution of combat ration packs that had been produced prior to 1 July 2008 to ADF personnel only (Army Headquarters 2009). As an added precaution, initial training units, who may be in the process of medical screening, are not to use these older ration packs, as the allergy caution is only on the outer box. SDSS (Standard Defence Supply System) ordering software includes the following warning in the commentary field which also prints on the picking slip as follows (O'Brien 2009):

Must check batch QCPI. No Ration Packs with a pack date prior to 01 Jul 08 are to be issued to any person other than ADF personnel. No Ration Packs with a pack date prior to 01 Jul 08 are to be issued to initial training units

To provide warning to consumers:

- All ADF Ration Packs are labelled with a warning affixed to the outer packaging.
- For the ration packs produced after 1 July 2008, ingredient sheets introduced a “CAUTION – FOOD ALLERGIES” warning statement and this advice was placed on the ingredients sheets as well as outer cartons; individual components were labelled with an ingredients list with allergen substances printed in bold (O'Brien 2009).
- Modified the warning label to include reference to the other major allergens for CRP manufactured after 2009-2010. The revised wording is as follows:

CAUTION- FOOD ALLERGIES

This ration pack has NOT been constituted for consumers with any food allergy or special dietary requirements. Products used in ration packs may contain nuts, tree nuts, cereals containing gluten, soy, fish, milk, egg, crustaceans, sesame seeds and their products and/or added sulphites. Check the ingredient list in the information sheet and/or product label before consumption. If you have any doubts about the contents, you should not consume the ration pack.

In summary, ADF combat ration packs are at present not accessible by cadets. Only ration packs with a “CAUTION - FOOD ALLERGIES” warning and extensive food allergen labelling on the ration contents are able to be accessed by non-service personnel.

Whilst there is a risk of accidental consumption by a non-service person who has a food allergy, it can be assumed that this risk is small. There is anecdotal evidence that CRP are occasionally used by non-service persons, including in humanitarian or disaster relief, where it is possible that persons may suffer a food allergy. However, guidance on provision of CRP to non-service persons is neither clear nor readily located.

6. Examination of Current CRP

A desktop analysis of the 2008/09 Australian Combat Ration One Man (CR1M) was conducted to determine the potential allergen content. The 2008/09 CR1M contains 71 individual food items, which are used in a variety of combinations to create eight menus (Menu A to Menu H). Each menu contains 14–17 items in addition to the 13 items common to all menus. The result is a set of menus comprising 232 food items. The average energy content of the menus is 17 MJ, with an average carbohydrate content of 640 g and protein content of 105 g.

6.1 Methods

The 2008/09 Combat Ration One Man (CR1M) was examined. The ingredient list for each food item in the eight menus was assessed, and the presence of cow's milk, hen's egg, finfish, shellfish, tree nuts, peanuts, wheat and soybeans or their derivatives as an ingredient was noted. Based on the results of this assessment, the major allergen content of the CR1M could be determined. Some items contained the warning '*may contain ...*', however information containing this level of detail was not available for all products.

The macronutrient composition of each menu of the 2008/09 CR1M was estimated using DSTO quality assurance data (where available), or nutritional estimates provided by either the manufacturer or Defence Materiel Organisation (DMO).

Each item found to contain a major food allergen as an ingredient was removed and, where possible, replaced with a suitable non-allergenic substitute item. The nutritional impact of removing and replacing these items was estimated. Maintaining the average original energy content and carbohydrate content of the eight 2008/09 CR1M menus was used as one criterion when substituting items.

6.2 Elimination of 'Nuts' and Seeds as Ingredients in CR1M Food Items

The number of items in the 2008/09 CR1M that contain 'nuts' as an ingredient is low (see Appendix A)—for the purposes of this sub-section, the term 'nuts' includes peanuts. The creation of eight CR1M menus free from products containing nuts is readily achievable.

Of the 71 individual items:

- *Peanuts* were not found (Chicken Satay, present in the 2007/08 menu, is not in the 2008/09 menu).
- *Tree nuts or seeds* were found in **four** food items
 - Chocolate Confectionery Spread (hazelnuts), Vanilla Confectionery Spread (hazelnuts), Beef Teriyaki (sesame oil), Vitalife Wellgrain Biscuit (sesame seeds).

Removal of the four items containing hazelnuts or sesame seeds from the menus reduces the energy content of those menus by 0.6–2.4 MJ. Other CR1M items can be used as replacements for these items. The following substitutions would provide alternative menus with energy and carbohydrate contents similar to the original. The changes to menus following these substitutions can be seen in Appendix B.

Remove Confectionery Spread (Chocolate and Vanilla).

- Replacement options:
- 2 x Candy Hard
 - Candy Chocolate (M&M's) *[warning may contain nuts]*
 - * Introduce new confectionery (no nut/seed ingredients)

Remove Beef Teriyaki.

- Replacement options:
- BBQ Beef
 - Beef Minced with Spaghetti
 - * Introduce new beef meal (no nut/seed ingredients)

Remove Vitalife Wellgrain Biscuit.

- Replacement options:
- Biscuit Krispie
 - * Introduce new cracker biscuit (no nut/seed ingredients)

- Of the remaining 67 items that do not contain nuts or seeds, warnings were provided for 35 items, 14 of which had a warning '*may contain traces of nuts*' or similar.

6.3 Elimination of Major Allergens as Ingredients in CR1M Food Items

Apart from peanuts, shellfish was the only other major allergen not found in the 2008/09 CR1M menus. Milk and wheat were the most commonly found allergens. To design a functional ration pack that is free from all major allergens would be a difficult, if not impossible, task. Appendix C shows the major allergen content of the ration pack, and it is clear that almost all of the items contain at least one of the major allergens.

Of the 71 individual items, that in various combinations make up the eight menus:

- *Shellfish* was not found.
- *Fish* was found in **four** food items:
 - Salmon and Pasta Mornay, Tuna in Springwater, Tuna with Dried Tomato, Worcestershire Sauce.

Menus C, E, F and G are free from food containing fish as an ingredient. Removal of the items containing fish would reduce the available energy from the remaining menus by up to 1.2 MJ. Other CR1M items could be used to fill these gaps to provide a menu of similar energy and macronutrient content.

- *Egg* was found in **two** food items:
 - Beef Minced with Tortellini, Scotch Finger Biscuit.

Menus A, B, C, D and H are free of products containing egg, and removal of the two items that contain egg would reduce the available energy from menus E, F and G by up to 1.4 MJ per menu. Other CR1M items could be used to fill these gaps to provide a menu of similar energy and macronutrient content.

- **Milk** was found in **20** food items:

- Beef Minced with Tortellini, Beef Soup, Candy Chocolate (M&M's), Cheddar Cheese, Chicken Soup, Chocolate Confectionery Spread, Chocolate Ration, Natural Muesli Cereal, Salmon and Pasta Mornay, Sausages and Vegetables, Savoury Soup, Scotch Finger Biscuit, Shrewsbury Biscuit, Skim Milk, Sweet Chilli Sauce, Sweetened Condensed Milk, Tomato Soup, Vanilla Confectionery Spread, Vitalife Wellgrain Biscuit, Worcestershire Sauce.

Many of the foods in the eight CR1M menus contain milk or milk derivatives, and removal of these products would reduce the available energy of each menu by 5.9–9.6 MJ. It would be difficult to find suitable substitutes for many of the milk-containing items, especially the condensed and powdered milks, which are used with the muesli and in the hot beverages.

- **Soy** was found in **27** food items:

- Apricot & Coconut Muesli Bar, BBQ Beef, BBQ Chicken, Beef and Gravy, Beef Minced with Spaghetti, Beef Minced with Tortellini, Beef Noodles, Beef Soup, Beef Teriyaki, Candy Chocolate (M&M's), Chewing Gum, Chicken Noodles, Chicken Soup, Chocolate Beverage Powder, Chocolate Confectionery Spread, Chocolate Ration, Forest Fruits Muesli Bar, Krispie Biscuit, Meatballs with Sweet and Sour Sauce, Sausages and Vegetables, Savoury Soup, Scotch Finger Biscuit, Shrewsbury Biscuit, Tomato Soup, Tropical Fruits Muesli Bar, Vanilla Confectionery Spread, Vegetable Curry.

Removal of these products reduced the available energy from the menus by 7.5–9.4 MJ. The identification of *equivalent* soy-free substitutes was relatively difficult.

- **Wheat** was found in **36** food items:

- Apricot & Coconut Muesli Bar, BBQ Beef, BBQ Chicken, Beef and Gravy, Beef Minced with Spaghetti, Beef Minced with Tortellini, Beef Noodles, Beef Soup, Beef Teriyaki, Blackcurrant Fruit Grains, Candy Chocolate (M&M's), Chewing Gum, Chicken Curry, Chicken Italiano, Chicken Noodles, Chicken Soup, Chocolate Ration, Crispbread Biscuit, Forest Fruits Muesli Bar, Hard Candy, Krispie Biscuit, Lamb with Rosemary, Meatballs with Sweet and Sour Sauce, Mix Berry Fruit Grains, Natural Muesli Cereal, Raspberry Fruit Grains, Salmon & Pasta Mornay, Sausages and Vegetables, Savoury Soup, Scotch Finger Biscuit, Shrewsbury Biscuit, Strawberry Fruit Grains, Tomato Soup, Tropical Fruits Muesli Bar, Vegetable Curry, Vitalife Wellgrain Biscuit.

More than half of the individual food items in the current CR1M contain wheat. Removal of all wheat products from the ration packs would reduce the available energy of the menus by 7.7–11.5 MJ and remove approximately half the carbohydrate content.

- *Cereals containing gluten* were found in **44** food items:
 - The 36 items containing wheat (see bullet point immediately above), plus Fruitful Muesli (oats), Grape Beverage Powder (dextrose), Mixed Berry Beverage Powder (dextrose), Orange Beverage Powder (dextrose), Sweet Chilli Sauce (trace amounts in raw materials), Tropical Beverage Powder (dextrose), Vegetable Extract (malt extract), Worcestershire Sauce.

Some individuals with coeliac disease can tolerate moderate amounts of pure oats, however the Dietitians Association of Australia (undated) includes ‘oats’ in the list of foods that may contain gluten. Removal of the items containing gluten would reduce the energy content of the menus by 9.0–12.8 MJ, and would remove about two-thirds of the carbohydrate content.

- Of the 71 items in the CR1M, warnings were provided for 35 items, **11** of which had a warning ‘*may contain ...*’ for one or more of egg, milk, wheat or soy.

Again, it must be noted that products with a warning ‘*may contain ...*’ or similar may need to be avoided by those with a relevant food allergy.

7. Discussion

There is a risk that a person may have an allergic reaction as a result of consuming food from an ADF ration pack. The severity of the risk is a function of the likelihood and consequences of exposure to the hazard, in this case allergens. Risk reduction may involve reducing the likelihood of exposure—for example, by controlling access to CRP so that susceptible individuals are not exposed—and reducing the consequences of exposure—for example, by removal of the most potent allergens.

Modification of CRP menus to remove items containing major allergens is a risk reduction exercise that needs to be balanced with the requirements of the ADF for a nutritious pack that is suitable for use in the field.

Creation of a variety of menus that do not contain peanuts, tree nuts or seeds as an ingredient is readily achievable, and examples of such have been provided in this report (Appendix B) by making a number of substitutions using items already in CRP. Products with a warning ‘*may contain nuts*’, or similar, may need to be avoided by those with a nut allergy. It has been suggested that consumers with food allergy are ‘increasingly ignoring advisory labelling’ (Hefle *et al.* 2007), but these products at times do contain detectable levels of nuts and therefore pose a risk. Although menus may not have nuts listed as an ingredient, assigning a ‘*nut-free*’ name or label to the ration or menus on that basis alone could be misleading. A classification such as this may imply that items have been tested and have been shown to be free of nuts.

Creating a functional ration pack that is free from all major allergens (peanuts, tree nuts and seeds, shellfish, fish, egg, milk, soy and wheat) is a much more difficult, if not impossible, task. Fish and egg are not widely used in CRP, however removal of fish from the menus has distinct disadvantages. Fish is an excellent source of protein, essential omega-3 fatty acids, iodine and some vitamins. It adds an element of variety, and the tuna used in CRP is an especially versatile and popular snack. Milk, soy and wheat are found in approximately half of the items. Milk is a good source of calcium, phosphorus and B-vitamins, so milk-free menus are likely to be low in these nutrients. Calcium is already marginal in CRP—without dairy products, available calcium would be even more limited.

Soy derivatives are commonly used in food processing as thickeners, protein fillers or emulsifiers, making it difficult to find soy-free processed foods suitable for use in ration packs. However, new ingredients are constantly being formulated, and ingredients and additives based on alternatives such as palm oil and rapeseed are now being used to replace the thickeners derived from soy. It is anticipated that in future, processed foods free from soy will be more readily available.

Removal of all items containing wheat as an ingredient not only leaves the ration with little variety, but also results in a pack that provides insufficient energy and carbohydrate to sustain high-intensity physical activity. Considering the number of items containing wheat, barley, rye and/or oats, the current CR1M is unsuitable for people with coeliac disease.

To design a ration pack that is free from all major allergens, commercial-off-the-shelf (COTS) items could be used, but the challenge would be to provide a collection of items with sufficient variety and nutritional content. Another difficulty would be finding COTS items that meet the shelf-life requirements for CRP items. Often COTS items proposed for inclusion in regular ration packs do not meet these stringent shelf-life requirements. In addition, COTS food items that are designed to be free of major allergens are usually specialised products and are priced accordingly. Suitable food items could be designed and developed specifically for use in CRP, but it is unlikely that a cost-benefit analysis would support this option.

Although it is possible to create a one-man ration pack that is free from foods using peanuts, tree nuts or seeds as ingredients, it may not be appropriate to do so. Nuts are a nutritious snack on their own, and contribute valuable nutrients to a composite food. They are a good source of protein, dietary fibre, mono- and poly-unsaturated fats, antioxidants and a range of vitamins and minerals. They also have a low glycaemic index, helpful for providing gradual energy release and thereby fuelling sustained physical activity. In field studies conducted by DSTO, many of the requests or suggestions from ADF members for new CRP items are for nuts or trail mix. These were also found to be a popular and well consumed during the trial of the Prototype Hot Weather Ration (Kullen, in preparation).

In other DSTO tasking, a holistic review of CRP is being conducted to determine what improvements can be made to the suite of ration packs. One of the main aims will be to propose a range of packs that are designed to cover the range of scenarios where CRP are used, or anticipated to be used. It may be appropriate to suggest that one or more packs will be restricted to combat or ADF use only, and others may be either for general use, cadet use, or for emergency or humanitarian operations. As cadets currently have no access to CRP, and considering the Defence White Paper commitment to humanitarian assistance and disaster relief

(Department of Defence 2009a) a requirement for new rations to suit these groups may be on the horizon.

Designing ration packs for combat/ADF use only would enable all items in the combat or ADF pack to be chosen from the full range of available foods, providing the best foods to sustain ADF members during their active duties. The general/emergency/humanitarian pack may be designed using foods that have a low allergen content, and provide enough energy to sustain a person for a short period of time, where non-serving personnel may be involved, for example during a cyclone, disaster relief and for unlawful entries. Products to be included in a general/emergency/humanitarian pack may be tested for major allergens as a further risk reduction measure. Discussions continue between DSTO and DMO as to what tests need to be continued or added as part of the quality assurance program for ration packs. Testing for allergens has been considered, especially for the products that have '*may contain ...*' warning labels.

8. Conclusions

- **The risk of an allergic reaction following the consumption of an ADF ration pack is cause for concern.** The death of a cadet following consumption of a CR1M food item provides stark evidence of the seriousness of this risk.
- **The ADF has a strategy in place to reduce the risk of an allergic reaction to a food contained in an ADF ration pack.** The two major elements of this strategy are:
 - (i) restriction of entry into the ADF to exclude people who have a food allergy, combined with discharge on medical grounds for those ADF members who are subsequently shown to have a severe food allergy or intolerance; and
 - (ii) A requirement for adherence to the food labelling legislation that demands the declaration on the packaging of major food allergens present in CRP items.

These strategies focus primarily on reducing the likelihood of exposure to an allergen.

- **The likelihood of access to CRP by non-Service persons is unclear in some respects.** Although there is good anecdotal evidence of CRP being used by non-Service persons, such as during disaster relief operations, no guidance for this type of usage could be located. CRP are not to be distributed outside the ADF unless they have the specified allergen labelling, but there is no guidance on what distribution is allowed if the labelling is in place. If the 'rules' were clear and well publicised then the options for risk reduction could be more confidently considered in context. This is germane to the consideration of how the associated risks might be managed.

- **The ADF could further reduce the risk by developing ration packs that do not use peanuts, tree nuts or seeds as ingredients, an approach that is readily achievable with the CR1M.** Nuts are the leading cause of food anaphylaxis and death from food allergy. Replacement of the few foods that contain nuts or seeds as an ingredient would further reduce the risk of accidental consumption by a nut allergy sufferer. An example of how to do this with the 2008/09 CR1M has been provided, and indeed at the time of writing this report, the items containing nuts have already been removed from the CR1M. Similar measures could be taken with other CRP (CR5M, PR1M). This has the disadvantage of eliminating foods that are of benefit to, and may be popular with, the majority of consumers.
- **Risk reduction via the development of combat ration packs that do not use any of the major allergens is neither feasible nor desirable.** The likelihood of a combat ration pack being consumed by an individual who suffers from a food allergy is not high, due to medical restrictions on enlistment and current restrictions on use by non-service personnel. The exclusion of components that contain the major allergens would jeopardise the nutritional content of the menus; this would not serve the interests of the majority of consumers. Adherence to the food labelling legislation provides warning to potential consumers who may suffer from a food allergy.
- **There is a demand for ration packs for use by non-ADF consumers.** The design and development of a general/emergency/humanitarian pack with a low allergen content could be considered as part of a new suite of rations. This ration pack could be used in situations where ADF has a lower level of control over the medical status of consumers, such as with cadets, in emergencies and during disaster relief operations. Clarification of the circumstances under which ration packs may be used by non-Service persons would facilitate the design process.

9. Recommendations

DSTO recommends that Defence:

- **Clarifies circumstances under which ration packs may be distributed to non-Service persons.**
- **Does not attempt to produce a combat ration pack that is free of major allergens.**
- **Considers the design and development of a low- or reduced-allergen ration pack for use by non-Service persons.**

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Appendix A: ‘Nut’ and Seed Content of CR1M

Australian Defence Force COMBAT RATIONS (ONE MAN)

Packed 2008/2009 – Ph1

Contents

The Combat Ration One Man is available in the eight menus shown below.
Due to unavoidable circumstances, items may be substituted.

Legend: **Item contains nuts as an ingredient**

Menu A		
Braised Beef and Gravy	Confectionery Spread – Choc	Milk, Dried Skim
Chicken, BBQ	Fruit Grains, Apricot	Sauce, Tomato
Soup, Savoury	Fruit Spread, Blackcurrant	Curry Powder
Bev Powder, Type II, Tropical	Fruit, Peaches, Diced	Sauce, Sweet Chilli
Biscuit, Crispbread	MB, Tropical Fruits	Tuna in Springwater
Biscuit, Krispie	Muesli Cereal, Fruitful	

Menu B		
Beef Teriyaki	Freeze Dried, Rice	MB, Forest Fruits
Salmon & Pasta Mornay	Fruit Grains, Blackcurrant	Noodles Chicken Flavour
Soup, Beef	Fruit Spread, Marmalade	Sauce, Sweet Chilli
Bev Powder, Type II, Grape	Fruit, Peaches, Diced	Sauce, Tomato
Biscuit, Shrewsbury	MB, Apricot & Coconut	
Biscuit, Vitalife Wellgrain	MB, Tropical Fruits	

Menu C		
Chicken Curry	Fruit Grains, Mix Berry	Noodles, Beef Flavour
Sausages & Vegetables	Fruit Spread, Raspberry	Sauce, BBQ
Bev Powder, Type II, Tropical	Fruit, Pears, Diced	Sauce, Tomato
Biscuit, Shrewsbury	MB, Apricot & Coconut	
Biscuit, Vitalife Wellgrain	Muesli Cereal, Natural	
Confectionery Spread – Vanilla	Milk, Dried Skim	

Menu D		
Beef BBQ	Confectionery Spread – Vanilla	MB, Forest Fruits
Chicken Italiano	Fruit Grains, Raspberry	Sauce, BBQ
Soup, Chicken	Fruit Spread, Plum	Sauce, Tomato
Bev Powder, Type II, Tropical	Fruit, Two Fruits, Diced	Sauce, Worcestershire
Biscuit, Crispbread	MB, Tropical Fruits	Tuna with Dried Tomato
Biscuit, Krispie	MB, Apricot & Coconut	

Menu E		
Beef Mince with Tortellini	Confectionery Spread – Vanilla	Milk, Dried Skim
Lamb with Rosemary	Fruit Grains, Strawberry	Noodles, Chicken Flavour
Soup, Tomato	Fruit Spread, Blackcurrant	Curry Powder
Bev Powder, Type II, Tropical	Fruit, Two Fruits, Diced	Sauce, Sweet Chilli
Biscuit, Crispbread	MB, Tropical Fruits	Sauce, Tomato
Biscuit, Krispie	Muesli Cereal, Fruitful	

Menu F		
Beef Meatballs, Sweet & Sour Sauce	Confectionery Spread – Chocolate	Muesli Cereal, Natural
Sausages and Vegetables	Fruit Grains, Apricot	Milk, Dried Skim
Soup, Tomato	Fruit Spread, Plum	Sauce, BBQ
Bev Powder, Type II, Mixed Berry	Fruit, Two Fruits, Diced	Sauce, Sweet Chilli
Biscuit, Scotch Finger	MB, Forest Fruits	
Biscuit, Vitalife Wellgrain	Noodles, Beef Flavour	

Menu G		
Chilli Con Carne	Fruit Grains, Blackcurrant	Sauce, Tomato
Beef Minced with Spaghetti	Fruit Spread, Raspberry	Sauce, Worcestershire
Soup, Beef	Fruit, Pears, Diced	
Bev Powder, Type II, Orange	MB, Tropical Fruits	
Biscuit, Scotch Finger	MB, Apricot & Coconut	
Biscuit, Vitalife Wellgrain	MB, Forest Fruits	

Menu H		
Baked Beans	Confectionery Spread – Vanilla	MB, Tropical Fruits
Vegetable Curry	Fruit Grains, Apricot	Sauce, Sweet Chilli
Soup, Savoury	Fruit Spread, Marmalade	Sauce, Tomato
Bev Powder, Type II, Mixed Berry	Fruit, Peaches, Diced	Tuna with Dried Tomato
Biscuit, Shrewsbury	MB, Apricot & Coconut	
Biscuit, Crispbread	MB, Forest Fruits	

Additional Food Items Common to all CR1M Menus		
Bev, Chocolate Powder	Candy Hard Various	Chewing Gum,
Bev, Coffee Instant	Milk, Sweet Condensed	Pepper, Black
Bev, Tea Bags	Cheese Cheddar Canned	Salt
Sugar	Chocolate Ration	
Candy Chocolate (M&M's)	Vegetable Extract	

Appendix B: CR1M — Nut and Seed Ingredients Removed

Australian Defence Force COMBAT RATIONS (ONE MAN)

Packed 2008/2009 – Ph1

Contents

The Combat Ration One Man is available in the eight menus shown below.
Due to unavoidable circumstances, items may be substituted.

Legend: **Substitution with no nut ingredients**

Menu A		
Braised Beef and Gravy	Candy Hard Various or Candy Chocolate (M&M's)	Milk, Dried Skim
Chicken, BBQ	Fruit Grains, Apricot	Sauce, Tomato
Soup, Savoury	Fruit Spread, Blackcurrant	Curry Powder
Bev Powder, Type II, Tropical	Fruit, Peaches, Diced	Sauce, Sweet Chilli
Biscuit, Crispbread	MB, Tropical Fruits	Tuna in Springwater
Biscuit, Krispie	Muesli Cereal, Fruitful	

Menu B		
BBQ Beef or Beef Minced with Spaghetti	Freeze Dried, Rice	MB, Forest Fruits
Salmon & Pasta Mornay	Fruit Grains, Blackcurrant	Noodles Chicken Flavour
Soup, Beef	Fruit Spread, Marmalade	Sauce, Sweet Chilli
Bev Powder, Type II, Grape	Fruit, Peaches, Diced	Sauce, Tomato
Biscuit, Shrewsbury	MB, Apricot & Coconut	
Biscuit, Krispie	MB, Tropical Fruits	

Menu C		
Chicken Curry	Fruit Grains, Mix Berry	Noodles, Beef Flavour
Sausages & Vegetables	Fruit Spread, Raspberry	Sauce, BBQ
Bev Powder, Type II, Tropical	Fruit, Pears, Diced	Sauce, Tomato
Biscuit, Shrewsbury	MB, Apricot & Coconut	
Biscuit, Krispie	Muesli Cereal, Natural	
Candy Hard Various or Candy Chocolate (M&M's)	Milk, Dried Skim	

Menu D		
Beef BBQ	Candy Hard Various or Candy Chocolate (M&M's)	MB, Forest Fruits
Chicken Italiano	Fruit Grains, Raspberry	Sauce, BBQ
Soup, Chicken	Fruit Spread, Plum	Sauce, Tomato
Bev Powder, Type II, Tropical	Fruit, Two Fruits, Diced	Sauce, Worcestershire
Biscuit, Crispbread	MB, Tropical Fruits	Tuna with Dried Tomato
Biscuit, Krispie	MB, Apricot & Coconut	

Menu E		
Beef Mince with Tortellini	Candy Hard Various or Candy Chocolate (M&M's)	Milk, Dried Skim
Lamb with Rosemary	Fruit Grains, Strawberry	Noodles, Chicken Flavour
Soup, Tomato	Fruit Spread, Blackcurrant	Curry Powder
Bev Powder, Type II, Tropical	Fruit, Two Fruits, Diced	Sauce, Sweet Chilli
Biscuit, Crispbread	MB, Tropical Fruits	Sauce, Tomato
Biscuit, Krispie	Muesli Cereal, Fruitful	

Menu F		
Beef Meatballs, Sweet & Sour Sauce	Candy Hard Various or Candy Chocolate (M&M's)	Muesli Cereal, Natural
Sausages and Vegetables	Fruit Grains, Apricot	Milk, Dried Skim
Soup, Tomato	Fruit Spread, Plum	Sauce, BBQ
Bev Powder, Type II, Mixed Berry	Fruit, Two Fruits, Diced	Sauce, Sweet Chilli
Biscuit, Scotch Finger	MB, Forest Fruits	
Biscuit, Krispie	Noodles, Beef Flavour	

Menu G		
Chilli Con Carne	Fruit Grains, Blackcurrant	Sauce, Tomato
Beef Minced with Spaghetti	Fruit Spread, Raspberry	Sauce, Worcestershire
Soup, Beef	Fruit, Pears, Diced	
Bev Powder, Type II, Orange	MB, Tropical Fruits	
Biscuit, Scotch Finger	MB, Apricot & Coconut	
Biscuit, Krispie	MB, Forest Fruits	

Menu H		
Baked Beans	Candy Hard Various or Candy Chocolate (M&M's)	MB, Tropical Fruits
Vegetable Curry	Fruit Grains, Apricot	Sauce, Sweet Chilli
Soup, Savoury	Fruit Spread, Marmalade	Sauce, Tomato
Bev Powder, Type II, Mixed Berry	Fruit, Peaches, Diced	Tuna with Dried Tomato
Biscuit, Shrewsbury	MB, Apricot & Coconut	
Biscuit, Crispbread	MB, Forest Fruits	

Additional Food Items Common to all CR1M Menus		
Bev, Chocolate Powder	Candy Hard Various	Chewing Gum,
Bev, Coffee Instant	Milk, Sweet Condensed	Pepper, Black
Bev, Tea Bags	Cheese Cheddar Canned	Salt
Sugar	Chocolate Ration	
Candy Chocolate (M&M's)	Vegetable Extract	

Appendix C: ‘Major Allergen’ Content of CR1M

Australian Defence Force COMBAT RATIONS (ONE MAN)

Packed 2008/2009 – Ph1

Contents

The Combat Ration One Man is available in the eight menus shown below.
Due to unavoidable circumstances, items may be substituted.

Legend:

<i>Item contains major allergens in ingredients</i>	Nuts/ Seeds	Fish	Milk	Egg	Wheat	Soy	Gluten
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Menu A

Braised Beef & Gravy					Confectionery Spread – Choc					Milk, Dried Skim				
Chicken, BBQ					Fruit Grains, Apricot					Sauce, Tomato				
Soup, Savoury		Yellow			Fruit Spread, B'currant					Curry Powder				
Bev Powder, Type II, Tropical					Fruit, Peaches, Diced					Sauce, Sweet Chilli				
Biscuit, Crispbread					MB, Tropical Fruits					Tuna in Springwater		Blue		
Biscuit, Krispie					Muesli Cereal, Fruitful									

Menu B

Beef Teriyaki	Orange				Freeze Dried, Rice					MB, Forest Fruits				
Salmon & Pasta Mornay		Blue	Yellow		Fruit Grains, B'currant				Green	Noodles Chicken Flavour			Green	Red
Soup, Beef					Fruit Spread, Marmalade					Sauce, Sweet Chilli				Yellow
Bev Powder, Type II, Grape					Fruit, Peaches, Diced					Sauce, Tomato				
Biscuit, Shrewsbury		Yellow			MB, Apricot & Coconut				Green	MB, Tropical Fruits				
Biscuit, Vitalife Wellgrain	Orange	Yellow												

Menu C

Chicken Curry					Fruit Grains, Mix Berry				Green	Noodles, Beef Flavour			Green	Red
Sausages & Vegetables		Yellow			Fruit Spread, Raspberry					Sauce, BBQ				
Bev Powder, Type II, Tropical					Fruit, Pears, Diced					Sauce, Tomato				
Biscuit, Shrewsbury		Yellow			MB, Apricot & Coconut				Green	MB, Tropical Fruits				
Biscuit, Vitalife Wellgrain	Orange	Yellow			Muesli Cereal, Natural				Green					
Confectionery Spread – Vanilla	Orange	Yellow			Milk, Dried Skim				Yellow					

Menu D

Beef BBQ					Confectionery Spread – Vanilla				Yellow	MB, Forest Fruits			Green	Red
Chicken Italiano					Fruit Grains, Raspberry				Green	Sauce, BBQ				
Soup, Chicken		Yellow			Fruit Spread, Plum					Sauce, Tomato				
Bev Powder, Type II, Tropical					Fruit, Two Fruits, Diced					Sauce, Worcestershire		Blue		
Biscuit, Crispbread					MB, Tropical Fruits				Green	Tuna with Dried Tomato		Blue		
Biscuit, Krispie					MB, Apricot & Coconut				Green					

Menu H															
Baked Beans						Confectionery Spread – Vanilla	Orange	White	Yellow			Red		MB, Tropical Fruits	
Vegetable Curry				Green	Red	Fruit Grains, Apricot							Sauce, Sweet Chilli		Yellow
Soup, Savoury		Yellow		Green	Red	Fruit Spread, Marmalade							Sauce, Tomato		
Bev Powder, Type II, Mixed Berry						Fruit, Peaches, Diced							Tuna with Dried Tomato		Blue
Biscuit, Shrewsbury		Yellow		Green	Red	MB, Apricot & Coconut				Green	Red	Grey			
Biscuit, Crispbread				Green	White	MB, Forest Fruits				Green	Red	Grey			

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19. ABSTRACT Food allergy is an immunological reaction to a component of food. Allergic responses are often immediate and can be minor, moderate, serious, or even result in death. Food allergies are believed to affect 2-5% of the general population, with children affected more commonly than adults. Eight major food allergens-milk, eggs, finfish, shellfish, tree nuts, peanuts, wheat and soybeans-are responsible for most allergic reactions, and food producers are required by law to declare these allergens where present in their food. Individuals with a food allergy are unlikely to be accepted into the ADF, but there is a small chance that persons, including civilians, suffering from food allergy may consume ration packs. The current CR1M was examined to determine if it would be practicable to remove nuts or other major allergens from the menus. The removal of four specific items-for which alternatives can readily be identified-from the current CR1M menus would result in CR1M being free of nut/seed ingredients. However, there are nutrition-related penalties involved in this course of action. Designing a major-allergen-free ration pack is not considered to be practicable nor desirable.				